THE TAYLOR FORMATION (HOLOCENE) AND ITS MACROFAUNAS, TAYLOR DRY VALLEY, ANTARCTICA (EXTENDED ABSTRACT)

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1. Prologue

An abstract and the basic tenets of this paper were presented by the author in Tokyo at the Dry Valley Drilling Project Seminar 3 (CHAPMAN-SMITH, 1978). The research is recorded here in extended abstract form because it will be published in detail elsewhere (CHAPMAN-SMITH, 1979). The full paper gives detailed descriptions of fossil localities and macrofaunas, together with a number of paleoecological and systematic paleontological observations. Radio-carbon age determinations of valves of *Adamussium colbecki* (SMITH, 1902) from the New Harbor deposits are discussed in the paper in press and deposition of lithologies in two differing sedimentary regimes is postulated to explain apparently contradictory data. A more comprehensive background to the stratigraphic nomenclature of the lower Taylor Valley, and an expanded discussion of the validity or invalidity of the Taylor Formation are also presented in the unabridged publication.

2. Introduction

During the 1973/1974 austral summer the Dry Valley Drilling Project completed two shallow holes (DVDP 8, 9) at New Harbor at the mouth of the Taylor Valley (Figs. 1 and 2). Detailed and summary drill logs of the vertical hole DVDP 9 which intersected intervals of sparsely macrofossiliferous lithologies, were prepared in the Thiel Earth Sciences Laboratory at McMurdo Station (CHAPMAN-SMITH and LUCKMAN, 1974).

Macrofaunas from the Taylor Valley had been collected previously by three workers: R. E. PRIESTLEY and B. ARMYTAGE in 1908, and W. ROMANES in 1958. PRIESTLEY and ARMYTAGE regarded the few specimens they collected from close to the New Harbor shoreline as evidence of past "raised beaches" (SHACKLETON, 1909; DAVID and PRIESTLEY, 1914). Like many later authors PRIESTLEY and ARMYTAGE drew attention to the widespread occurrence throughout the McMurdo Sound region of "raised" fossiliferous marine deposits and much debate has taken place over

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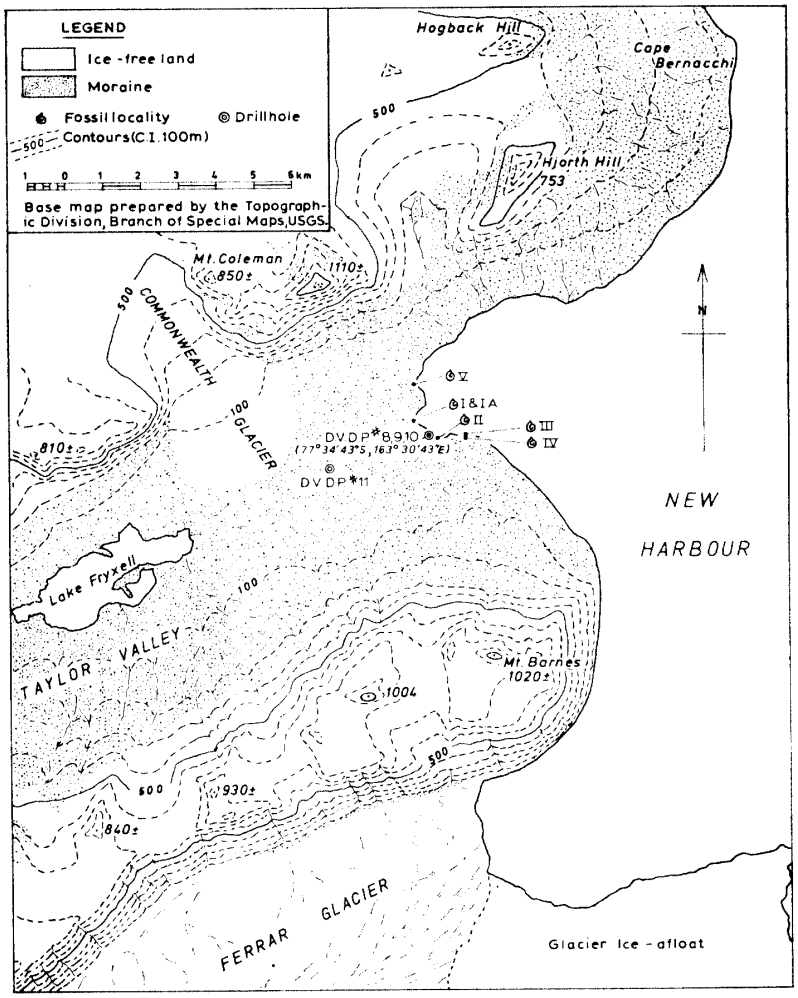

Fig. 1. Locality map of lower Taylor Valley area showing positions of fossil localities and of DVDP drillholes 8, 9, 10 and 11.

their origin (DAVID and PRIESTLEY, 1914; CHAPMAN, 1916; DEBENHAM, 1920; NICOLS, 1961a, b). Correlatives of these deposits have been described from Princess Elizabeth Land (CRESPIN, 1960) and from Wilkes Land (CAMERON *et al.*, 1959).

SPEDEN (1962) published an extensive review of all the then known fossiliferous Quaternary deposits of the McMurdo Sound region and divided them into two new Formations each with a characteristic faunal assemblage. The younger Last Interglacial and Postglacial assemblage is characterised by the extant *Adamussium colbecki* (SMITH) found amongst unconsolidated marine sediments of the Taylor Formation. SPEDEN erected the Taylor Formation with the type locality as the New Harbor locality from which PRIESTLEY and ARMYTAGE had collected *Adamussium colbecki* and other species in 1908, near the south side of the mouth of the Taylor Valley. The

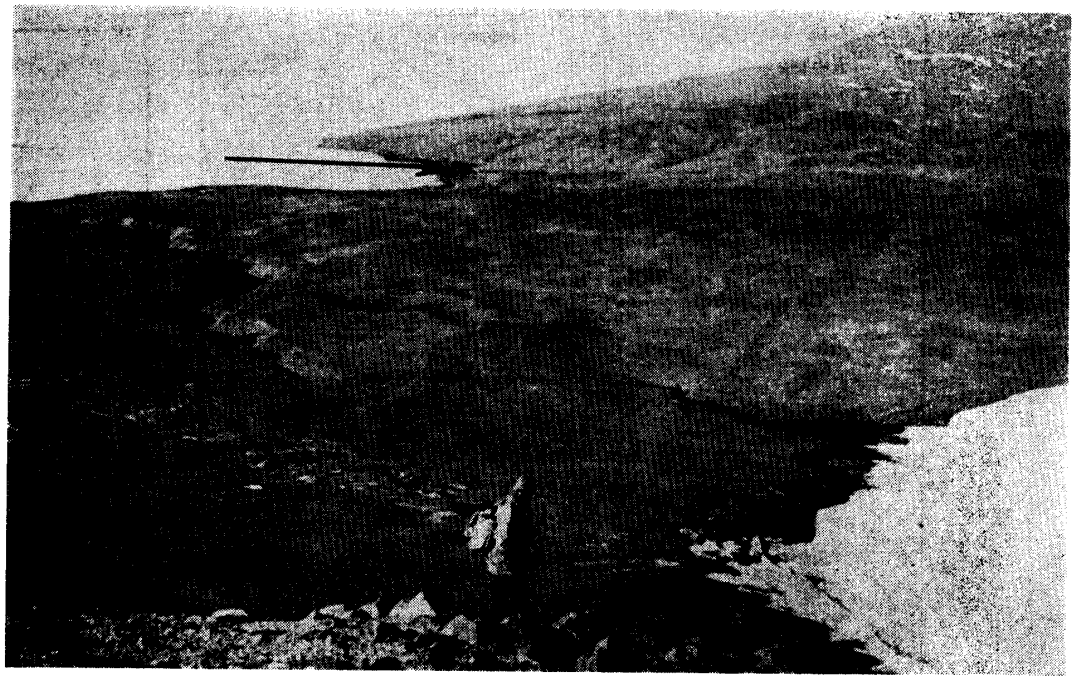

Fig. 2. View south from Mt. Coleman across Taylor Valley to the slopes of Mt. Barnes. The New Harbor site of DVDP drillholes 8, 9 and 10 is indicated by the arrow. The terminal face of the Commonwealth Glacier is 800 m below the author in the right foreground.

locality is thus obviously in close proximity to the Dry Valley Drilling Project's New Harbor site at the mouth of Wales Stream.

As the drill penetrated fossiliferous lithologies in DVDP 8 the author decided it was an opportune time to recollect and examine macrofossils from the Taylor Formation. A number of previously unrecognised fossil localities were found and a considerable number of specimens collected.

3. Description of Fossil Localities

PRIESTLEY and ARMYTAGE (SHACKLETON, 1909; DAVID and PRIESTLEY, 1914) stated they found "a raised beach . . . near New Harbor (which) consisted of dark gritty sand containing numerous entire valves of *Adamussium colbecki* up to elevations of about 50 feet (15 m) above sea level, and at a distance of several hundreds of yards (say 275 m) inland from the present shore". The writer searched the New Harbor coastline from beneath Mt. Barnes at the mouth of the Ferrar Fjord, north to below Hjorth Hill finding fossil localities in many places around the mouth of Taylor Valley close to the New Harbor shoreline. However no significant numbers of fossils were found higher than 7.6 m above H.T.M. (high tide mark) or further inland than 75 m from H.T.M. PRIESTLEY and ARMYTAGE's locality is likely to be close to the DVDP

Fig. 3. Fossil locality IV. Superficial lag gravel has been removed showing valves of Adamussium colbecki.

drill site, near the mouth of Wales Stream which debouches into New Harbor. Here there is a considerable distance between the high and low tide marks, and the anomalies between the writer's measurements and PRIESTLEY and ARMYTAGE's statements might be explained if the latter took the low tide mark as their datum.

All localities are distinguished by the appearance of fragile brown-red valves of *Adamussium colbecki* protruding through a superficial lag gravel 1–3 cm in thickness (Fig. 3). The positions of the fossil localities are shown in Figs. 1 and 2.

4. Faunal List of New Harbor Collections (Table 1)

1) Collections from Localities I, IA, II, III, IV, V, DVDP 9 and "New Harbor Campsite" are from fossiliferous Holocene beach deposits and were made by the writer. Dr. J. H. W. WRENN helped collect from Localities I and II; Dr. K. WATANUKI and Mr. R. G. SMITH also assisted at Locality II.

2) Specimens recorded from "New Harbor Shoreline" are recent and collected by the writer and Dr. J. H. W. WRENN.

3) The "New Harbor Campsite" locality is that used by the Dry Valley Drilling Project as a campsite during the drilling of holes 8 and 9.

4) SPEDEN (1962) recorded three assemblages from the New Harbor area. They are listed here under their original collectors; PRIESTLEY, ARMYTAGE and

Table. 1. Faunal list of New Harbor collections.

	Localities						New Harbor Campsite	DVDP 8, 9	New Harbor Shoreline	2* PRIESTLEY & ARMYTAGE	15* PRIESTLEY & ARMYTAGE	31* ROMANES
	I	IA	II	III	IV	V						
Bivalvia												
Adamussium colbecki (SMITH, 1902)	37p, fa	39p, fc	57p, fa	31p, f	61p, fa	24p, f	1f	p, f	92p, f	x		x
Thracia meridionalis SMITH, 1885	158p		2	10p	3p	1						
Laternula elliptica (KING & BRODERIP, 1831)	f		f	fc		fa		?p	1f	?		
Lima sp.										x		
Bivalvia indet.		x										
Gastropoda								x				
Subonoba contigua POWELL, 1958		2										
Neobuccinum eatoni (SMITH, 1875)	3		2f		1f	1						
Lorabela plicatula (THIELE, 1912)			1									
Philine apertissima SMITH, 1902	6	1	1		1	sp. 2f						
Echinodermata												
Sterechinus neumayeri (MEISSNER, 1900)	fc	fa	fc	fc	fa	fa	fa	?	x			?
Odontaster validus KOEHLER												x
Psilaster charcoti (KOEHLER, 1906)									x			
Ophiuroidea-ossicles	10	78	8		1		21					
Annelida												
Spirorbis sp.		3							x			
Serpulidae indet.		1										
Arthropoda												
Pycnogonida	?f								x	x	x	
Ostracoda								x				
Amphipoda											x	
Vertebrata												
Teleost-vertebrae, bones					x		x				x	
Pygoscelis adeliae-bones									x			
Cetacea-tooth									x			
Pinnipedia-bones									x			
Pinnipedia-teeth										x		
Foraminifera, undifferentiated	x	x	x	x	x	x	x	x				

Key: Number, say 18-Number of specimens collected; p-Presence of paired valves; f-Fragments(uncommon); fc-Fragments (common); fa-Fragments(abundant); x-Present, undifferentiated; 2*, 15*, 31*-SPEDEN's locality numbers.

ROMANES but with SPEDEN's locality numbers.

5. Is the Taylor Formation a Valid Stratigraphic Unit?

SPEDEN (1962) defined the Taylor Formation as "frozen but unconsolidated marine silts, sands, muds and perhaps gravel containing a varied fauna including *Adamussium colbecki*". SPEDEN was unable to visit New Harbor and relied upon the descriptions of DAVID and PRIESTLEY (1914) and DEBENHAM (1920) for accounts of the locality from which PRIESTLEY and ARMYTAGE collected their fauna, and which he (SPEDEN) designated as the type locality for the Taylor Formation. SPEDEN (1962) stated that "the type locality is the only one that does not overlie ice and is not admixed with moraine". It seems clear that it is only at the type locality that the faunas are likely to be *in situ*, fossilised and older than recent.

The Dry Valley Drilling Project has demonstrated that the fossiliferous sediments at the type locality extend to well below the surface. The three drill holes at New Harbor, DVDP 8, 9 and 10 terminated at depths of 157.06 m, 38.34 m and 185.47 m respectively (CHAPMAN-SMITH and LUCKMAN, 1974; MCKELVEY, 1975). Furthermore WEBB and WRENN (1979) correlate sediments encountered in the New Harbor drill-holes with lithologies intersected in DVDP 11 at Commonwealth Glacier and with sediments recovered from DVDP 15 in McMurdo Sound. Obviously these correlatives are totally different from the sediments SPEDEN ascribed to the Taylor Formation away from its type locality.

Clearly there are now two groups of fossiliferous sediments within the Taylor Formation; firstly the sequence at New Harbor which is in excess of 150 m thick at the type locality; and secondly a "carpet-bag" group of sediments that are similar in faunal content and in physiographic position in that they are underlain by ice.

To make matters worse, several workers in the lower Taylor Valley prior to the Dry Valley Drilling Project erected additional and overlapping stratigraphic units. For instance MURRELL (1973) described two members, the "Hjorth Sand" at New Harbor and the overlying "Suess Till". Both members were included in his "Canada Formation". MURRELL, who had read SPEDEN's paper, failed to even mention the obvious overlap between the Taylor and Canada Formations. MCCRAW (1967), ANGINO *et al.* (1962) and WEBB and NEAL (1972) all published additional lithologic and stratigraphic detail from the lower Taylor Valley.

It is clear that stratigraphic units proposed for deposits in the lower Taylor Valley overlapped even before the information gained from the drilling project, that sediments currently considered to be within the Taylor Formation are inconsistent with those at the type locality, and that a revision of the stratigraphy is required. Cores from drill-holes completed by the Dry Valley Drilling Project in the Taylor Valley should be used to redefine the Taylor Formation, a name which should take preference over units such as the Canada Formation of MURRELL (1973).

6. Summary

Macrofaunas were collected from the New Harbor area at the entrance to the Taylor Valley during the drilling of the Dry Valley Drilling Project Holes 8 and 9. Small collections by previous workers were reviewed by SPEDEN (1962) who ascribed them to fossiliferous sediments of the Taylor Formation. Although the faunas here listed comprise the largest macrofossil collections yet made from Cenozoic deposits of the Dry Valley region of Antarctica, they are sparse with the pectinid *Adamussium colbecki* (SMITH, 1902) being the predominant taxon.

Six molluscan species are recorded for the first time from the New Harbor deposits. It is believed that this is the first record of the gastropod taxa *Subonoba contigua* POWELL 1958, *Lorabela plicatula* (THIELE, 1912) and *Philine apertissima* SMITH 1902, having been found fossil.

SPEDEN (1962) erected the Taylor Formation for sediments containing the New Harbor faunas. Consideration of the original description, type locality, type faunas and correlatives of the Taylor Formation leaves little doubt that this stratigraphic unit requires redefinition. It is concluded that the Taylor Formation has precedence over alternative names, and that it is a valid stratigraphic unit which should be redefined using information obtained by the Dry Valley Drilling Project.

References

ANGINO, E. E., TURNER, M. D. and ZELLER, E. J. (1962): Reconnaissance geology of Lower Taylor Valley, Victoria Land, Antarctica. Bull. Geol. Soc. Am., **73**, 1553–1562.

CAMERON, R. L. and Others (1959): Wilkes Station Glaciological Data 1957–58. Ohio State Univ. Rep. 825, I.G.Y. Project, **4**, part 10, 1–173.

CHAPMAN, F. (1916): Report on the foraminifera and ostracoda from elevated deposits on the shores of the Ross Sea. Rep. Sci. Invest. Br. Antarct. Exped. 1907–09, Geol., **2**, 27–52.

CHAPMAN-SMITH, M. and LUCKMAN, P. G. (1974): Late Cenozoic glacial sequence cored at New Harbor, Victoria Land, Antarctica (DVDP 8, 9). DVDP Bull., **3**, 120–148.

CHAPMAN-SMITH, M. (1978): The Taylor Formation (Holocene) and its macrofaunas, Taylor Dry Valley, Antarctica. DVDP Bull., **8**, 9–10.

CHAPMAN-SMITH, M. (1979): The Taylor Formation (Holocene) and its macrofaunas, Taylor Dry Valley, Antarctica. To be published in Antarctica Research Series.

CRESPIN, I. (1960): Some recent foraminifera from Vestfold Hills, Antarctica. Sci. Rep. Tohoku Univ., Hanzawa Mem. Vol. Spec., **4**, 19–31.

DAVID, T. W. E. and PRIESTLEY, R. E. (1914): Glaciology, Physiography, Stratigraphy and Tectonic Geology of South Victoria Land. Rep. Sci. Invest. Br. Antarct. Exped. 1907–09, Geol., **1**, 319 p.

DEBENHAM, F. (1920): A new mode of transportation by ice: the raised marine muds of South Victoria Land. Q. J. Geol. Soc. London, **75**, 51–76.

MCKELVEY, B. C. (1975): DVDP sites 10 and 11, Taylor Valley. DVDP Bull., **5**, 16–24.

MCCRAW, J. D. (1967): Soils of Taylor Valley, Victoria Land, Antarctica, with notes on soils from other localities in Victoria Land. N. Z. J. Geol. Geophys., **16** (2), 225–242.

NICHOLS, R. L. (1961a): Coastal geomorphology, McMurdo Sound, Antarctica: Preliminary

report. I.G.Y. Glaciol. Rep., **4**, 51–101.

NICHOLS, R. L. (1961b): Characteristics of beaches formed in polar climates. I.G.Y. Glaciol. Rep., **4**, 103–113.

POWELL, A. W. B. (1958): Mollusca from the Victoria—Ross Quadrants of Antarctica. B.A.N.Z. Antarct. Res. Exped. Rep., Ser. B (Zool. Bot.), **6** (9), 167–215.

SHACKLETON, E. H. (1909): The Heart of the Antarctic being the Story of the British Antarctic Expedition 1907–09, 2 vol. London, W. Heinemann, 372+419 p.

SMITH, E. A. (1902): Report on the collections of Mollusca made in the Antarctic during the voyage of the *"Southern Cross" Part 7*, 201–213.

SPEDEN, I. G. (1962): Fossiliferous Quarternary marine deposits in the McMurdo Sound region, Antarctica. N. Z. J. Geol. Geophys., **5** (5), 746–777.

THIELE, J. (1912): Die antarktischen und subantarktischen und Muscheln. Dtsch. Sudpolar Exped. 1901–03, **13**, 183–285.

WEBB, P. N. and NEALL, V. (1972): Cretaceous foraminifera from Quaternary deposits in Taylor Valley, Antarctica. Antarctic Geol. Geophys., ed. by R. J. ADIE. Oslo, Universitetsforlaget, 653–657.

WEBB, P. N. and WRENN, J. H. (1979): Late Cenozoic micropaleontology and biostratigraphy of eastern Taylor Valley, Antarctica. To be published in Antarctic Geoscience, ed. by C. CRADDOCK. Madison, University of Wisconsin Press.

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